TABLE OF CONTENTS ~ INTRODUCTION

1 Introduction
- 1.1 General
- 1.2 Units
- 1.3 Definitions
- 1.4 Abbreviations and notation
- 1.5 References
  - 1.5.1 Direct
  - 1.5.2 Indirect
- 1.6 Revisions

1 Introduction

1.1 General

This series of articles summarizes the definitions, abbreviations and notation, references, and design assumptions for the manual, but the summary is not comprehensive. Additional definitions, abbreviations and notation, and references are given with specific sections and articles in the manual.

1.2 Units

Bridge Design Manual is written in dual units. Customary U.S. or English units are given first, and SI metric units are given second, in parenthesis.

1.3 Definitions [AASHTO-I 3.7, AASHTO-LRFD 3.3.2]

See additional definitions with each major article.

Article refers to any numbered subdivision within a section of a direct reference such as *AASHTO LRFD Bridge Design Specifications, Bridge Design Manual,* or *Standard Specifications for Highway and Bridge Construction*. All of the following are articles: 1.1, 1.1.1, 1.1.1.1, and 1.1.1.1.1.

Average span length (ASL) is the average length of the two spans adjacent to a pier. See Figure 1.3-1.

Bridge length (BL) for structural design is the length from centerline of abutment bearing to centerline of abutment bearing. See Figure 1.3-1. In some situations bridge length may be taken as the length from expansion joint to expansion joint.

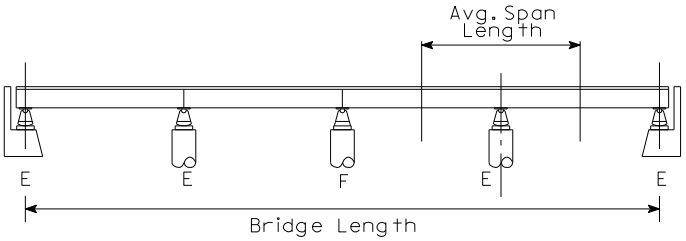

Figure notes:

- E indicates an expansion support.
- F indicates a fixed support.

Figure 1.3-1. Length definitions

Built-in wearing surface is taken as the top one-half inch (13 mm) of the original bridge deck. Weight of the built-in wearing surface is considered part of DC1, non-composite dead load of structural components and nonstructural attachments, [AASHTO-LRFD 3.3.2] (or Dead Load 1 under the AASHTO Standard Specifications), but the wearing surface is not considered to contribute to the strength or stiffness of any part of the superstructure.

Dead Load 1 is a designation for non-composite dead load that the office used with the AASHTO Standard Specifications. Under LRFD the office designates Dead Load 1 as DC1, non-composite dead load of structural components and nonstructural attachments [AASHTO-LRFD 3.3.2], which typically includes beams, deck, haunches, and diaphragms. It is applied to the beams *before* the deck concrete cures.

Dead Load 2 is a designation for composite dead load that the office used with the AASHTO Standard Specifications. Under LRFD the office designates Dead Load 2 as either DC2 or DW based on the AASHTO definitions [AASHTO-LRFD 3.3.2]. DC2 is composite dead load of structural components and nonstructural attachments including barrier rails, sidewalks, curbs, and medians that are not part of the initial deck pour. It is applied to the composite beams *after* the deck concrete cures. Curing of the concrete deck changes the load-carrying behavior of the superstructure by making the deck composite with beams. Parts of DC2 are applied differently depending on design conditions. Under LRFD, future wearing surfaces and utility lines, which formerly were part of Dead Load 2, are in a new load designation, DW [AASHTO-LRFD 3.3.2].

Future wearing surface (FWS) is a concrete or hot mix asphalt overlay applied to the original bridge deck. Office practice is to consider the future wearing surface part of DW under the AASHTO LRFD Specifications (or Dead Load 2 under the AASHTO Standard Specifications) at 0.020 ksf (960 Pa) but to neglect any potential contribution of the overlay to strength or stiffness of the superstructure.

HS25 live load is defined as the following [OBS MM No. 157]:

- The lane load shall be taken as a uniform load of 800 pounds per linear foot of load lane and a concentrated load of 22,500 pounds for moment and 32,500 pounds for shear [AASHTO-I 3.7.1.2, 3.7.1.3, and Figure 3.7.6B].
- The HS truck shall have a front axle weight of 10,000 pounds and two following axles of 40,000 pounds each. Axle spacing shall be the same as for HS-20 loading [AASHTO-I 3.7.6 and Figure 3.7.7A].
- The Alternate Military Loading shall remain without increase, as given in the specifications [AASHTO-I 3.7.4].

Longitudinal is the direction associated with the roadway centerline of construction and main girders. See Figure 1.3-2.

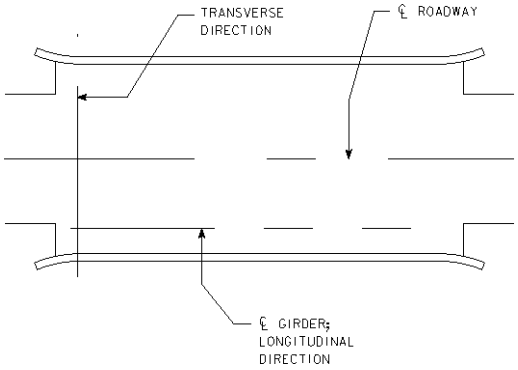

Figure 1.3-2. Longitudinal and transverse direction definitions

National Highway System (NHS) is composed of the Interstate and Commercial and Industrial Network. Routes in Iowa including the following, as illustrated in Figure 1.3-3.

- Interstate routes: I-29, I-35, I-74, I-80, I-129, I-235, I-280, I-380, and I-480
- Federal routes: US 18 east of IA 60, US 20, US 30, US 34, US 52 north of US 20, US 61, US 63 north of US 20, US 63 south of IA 92, US 71, US 75, US 151 north of US 30, US 169 north of IA 141 and south of US 18, US 218 south of US 18 and north of I-380
- State routes: IA 14, IA 60, IA 141 east of US 169, IA 163 east of I-235, and IA 330

There are additional routes in urbanized areas as summarized below, however, the designer is cautioned to check the latest NHS maps because of complexity of routes and corridor shifts.

- Cedar Rapids: IA 100
- Council Bluffs: US 6 west of I-80
- Davenport: US 67 west of I-74
- Des Moines: US 65 south of I-80, US 69 south of I-235, IA 5, IA 28
- Sioux City: IA 12
- Waterloo: IA 58 north of US 20

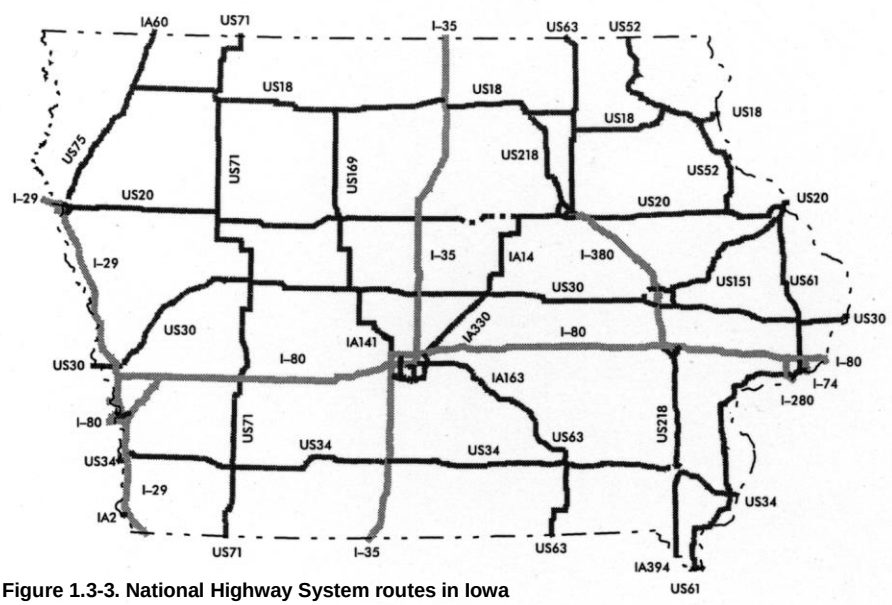

Figure 1.3-3. National Highway System routes in Iowa

Natural ground elevation is the average natural ground elevation along the longitudinal centerline of the foundation.

Office refers to the Office of Bridges and Structures, Iowa Department of Transportation.

Primary Highway System: "Primary roads" or "primary road system" means those roads and streets both inside and outside the boundaries of municipalities which are under department (defined as state department of transportation) jurisdiction [Iowa Code 306.3.6].

Section refers to a chapter or division of a direct reference such as *AASHTO LRFD Bridge Design Specifications, Bridge Design Manual,* or *Standard Specifications for Highway and Bridge Construction*. The following are examples of sections: 1., 2., and 3.

Section Leader is the supervisor of the Office of Bridges and Structures preliminary bridge section, detail design section, or consultant coordination section.

Substructure is any construction below the bearing seats or, in the absence of bearings, below the soffit of the superstructure.

Transverse is the direction normal to the roadway centerline of construction and main girders. See Figure 1.3-2.

1.4 Abbreviations and notation [AASHTO-I 3.7, 3.8, AASHTO-LRFD 3.3.2, 3.6.1, 3.6.2]

See additional abbreviations and notation with each major article.

ASL, average span length
BL, bridge length
CCS, continuous concrete slab
CWPG, continuous welded plate girder
D, dead load, including both Dead Load 1 and Dead Load 2
DC1, non-composite dead load of structural components and nonstructural attachments such as beams, deck, haunches, and diaphragms [AASHTO-LRFD 3.3.2]. Before LRFD the office termed this load Dead Load 1.
DC2, composite dead load of structural components and nonstructural attachments such as barrier rails, sidewalks, curbs, and medians that are not part of the initial deck pour [AASHTO-LRFD 3.3.2]. Before LRFD the office considered these loads part of Dead Load 2.
DL1, Dead Load 1
DL2, Dead Load 2
DW, dead load of wearing surfaces and utilities [AASHTO-LRFD 3.3.2]. Before LRFD the office included these loads in Dead Load 2.
FWS, future wearing surface
I, live load impact [AASHTO-I 3.8]
IM, dynamic load allowance [AASHTO-LRFD 3.6.2]
L, live load, HS20 (MS-18) truck load or lane load, whichever has greater effect; military load, if applicable [AASHTO-I 3.7]
LL, live load, HL-93 [AASHTO-LRFD 3.6.1]
LRFD, load and resistance factor design
N or N-value, standard penetration test number of blows per foot (300 mm). N also may be given as **SPT NO**, the Standard Penetration Number, in the soils information chart reference.
NHS, National Highway System
OBS, Office of Bridges and Structures
PPCB, pretensioned prestressed concrete beam
RSB, rolled steel beam
TS&L, type, size, and location

1.5 References

1.5.1 Direct

Throughout *Bridge Design Manual* there are frequent, direct references to specific portions of standards, publications, and update memos. Direct references are included in brackets [ ] using the abbreviations given below. Applicable references to the AASHTO LRFD Specifications and, in a few cases, to the Standard Specifications are given with each article heading.

Although the latest editions are listed below there are some circumstances in which documents referenced in this manual have been prepared on the basis of previous editions.

[AASHTO-division article, table, or figure] refers to AASHTO *Standard Specifications for Highway Bridges, 17th Edition (2002)* with current errata changes - design, seismic design, or construction division with article, table, or figure number.

[AASHTO-LRFD article, table, or figure] refers to *AASHTO LRFD Bridge Design Specifications, 4th Edition (2007) with 2008 and 2009 Interim Revisions* with article, table, or figure number.

[AASHTO-Temp article, table, or figure] refers to *Guide Design Specification for Bridge Temporary Works* with article, table, or figure number.

[AASHTO-Sign article, table, or figure] refers to AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 5th Edition 20094th ~~Edition with 2002, 2003, and 2006 interim revisions~~* with article, table, or figure number.

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[BDM article, table, figure, or note] refers to *LRFD Bridge Design Manual* with article, table, figure, or plan note number. (Available on the Internet at http://www.iowadot.gov/bridge/manuallrfd.htm~~http://www.dot.state.ia.us/bridge/manuallrfd.htm~~)

[IDOT DS-number] refers to an Iowa Department of Transportation developmental specification, which is a hybrid of a supplemental specification and special provision.

[IDOT PPM policy number] refers to a policy in the Iowa Department of Transportation *Policies and Procedures Manual.*

[IDOT SS article] refers to Iowa Department of Transportation *Standard Specifications for Highway and Bridge Construction, Series 2009~~2001~~* with article number. (Available on the Internet at: http://www.iowadot.gov/erl/index.html~~erl.dot.state.ia.us/~~)

[OBS MM No. number] refers to a policy-update, methods memo issued by the Office of Bridges and Structures, Highway Division with memo number, dated 2001 or later. (Available in *Bridge Design Manual Commentary* and on the Internet at: http://www.iowadot.gov/bridge/mthdmemo.htm)

[OBS SS sheet number] refers to an Office of Bridges and Structures, Highway Division “Standard Sheet” with sheet number. (Available on the Internet at: http://www.iowadot.gov/bridge/v8ebrgstd.htm)

[OD DM article, table, or figure] refers to the Office of Design, Highway Division *Design Manual* with article, table, or figure number. (Available on the Internet at: http://www.iowadot.gov/design/dmanual/manual.html?reload~~ftp://165.206.203.34/design/dmanual/00_START%20HERE_TOC.pdf~~)

[OD RDD sheet number] refers to the Office of Design, Highway Division “Road Design Details” with sheet number. Formerly the detail manual was referred to as the “green book.” (Available on the Internet at: http://www.iowadot.gov/design/desdet.htm)

[OD SRP sheet number] refers to an Office of Design, Highway Division “Standard Road Plan” with sheet number. Formerly the plan manual was referred to as the “red book.” (Available on the Internet at: http://www.iowadot.gov/design/stdrdpln.htm~~erl.dot.state.ia.us/~~)

[OM IM number] refers to Office of Materials, Iowa Department of Transportation Instructional Memorandum number. (Available on the Internet at: http://www.iowadot.gov/erl/current/IM/Navigation.nav.pdf~~erl.dot.state.ia.us/~~)

1.5.2 Indirect

Indirect references are general and infrequent sources of information for *Bridge Design Manual* that usually are not linked with specific article or section numbers. The list below is not complete; see major articles for applicable complete lists.

American Association of State Highway and Transportation Officials (AASHTO). *Manual for Bridge Evaluation, First Edition~~Manual for Condition Evaluation of Bridges~~*. Washington: AASHTO, 2008~~1994~~.

American Concrete Institute (ACI). *Building Code Requirements for Structural Concrete (ACI 318-02) and Commentary (ACI 318R-02).* Farmington Hills: ACI, 2002.

American Institute of Steel Construction (AISC). *Steel Construction Manual, Thirteenth Edition.* Chicago: AISC, 2005.

American Railway Engineering and Maintenance-of-Way Association (AREMA). *Manual for Railway Engineering—2002 Edition*. Landover: AREMA, 2002.

American Society for Testing and Materials (ASTM). *2001 Annual Book of ASTM Standards*. West Conshohocken: ASTM, 2001.

American Welding Society (AWS). *Bridge Welding Code, AWS D1.5-2002* with 2003 interim revision. Miami: AWS, 2002.

Dirks, Kermit and Patrick Kam. *Foundation Soils Information Chart, Pile Foundation*. Ames: Iowa Department of Transportation, Office of Road Design, January 1989/September 1994.

Greimann, L.F., R.E. Abendroth, D.E. Johnson, and P.B. Ebner. *Final Report, Pile Design and Tests for Integral Abutment Bridges, HR-273, and Addendum.* Ames: Iowa Department of Transportation and College of Engineering, Iowa State University, 1987.

Lundquist, William A. *Iowa DOT Bridge Design Office Metric Handbook.* Ames: Office of Bridges and Structures, 1994 updated through 1996.

National Steel Bridge Alliance (NSBA). *Highway Structures Design Handbook.* Chicago: NSBA, 1993.

Office of Construction. *Construction Manual.* Ames: Office of Construction, Iowa Department of Transportation, 2006. (Available on the Internet at: http://www.iowadot.gov/erl/current/CM/Navigation/nav.pdf~~erl.dot.state.ia.us/~~)

Precast/Prestressed Concrete Institute (PCI). *Bridge Design Manual.* Chicago: PCI, 1997 with revisions through 2004. (Available on the Internet at: http://www.pci.org/publications/bridge/)

Sunday, Wayne and Kyle Frame. *New Bridge Construction Handbook.* Ames: Office of Construction, Iowa Department of Transportation, 2000. (Available on the Internet at: http://www.iowadot.gov/construction/structures/bridge_construction_handbook.pdf)

1.6 Revisions

Users are invited to send suggestions for revisions to the Methods Section of the Office of Bridges and Structures. Suggestions need to be written, with identification of the problem, recommended revision, and reason for recommendation.

All revisions affecting office policy will be approved by the Assistant Bridge Engineer.

After *Bridge Design Manual* is complete, approved policy and editorial revisions will be noted in a log in Appendix A and indicated with a line in the margin of the design manual text.